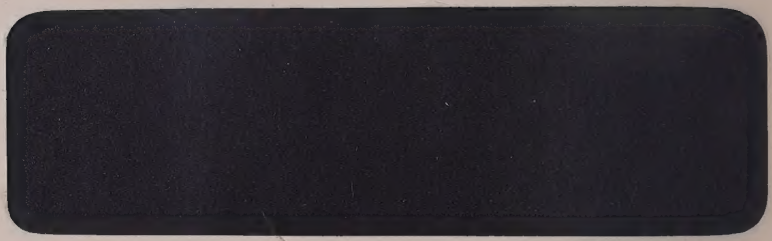
TG LAB.
CALIBRATED
NOT TO BE USED
AFTER G.
ISSUE TO G. QUIRK
AT
CALIBRATED BY

TG. LAB. G. QUIRK

V.L.F. OSCILLATOR
TYPE 442

INSTRUCTION BOOK

DAWE INSTRUMENTS LIMITED



OPERATING INSTRUCTIONS FOR

TG LAB. G QUIRK

V.L.F. OSCILLATOR
TYPE 442

DAWE INSTRUMENTS LIMITED
99 UXBRIDGE ROAD
EALING, LONDON, W.5
EALing 6215 (3 lines)

JUNE, 1960

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1. SCHEDULE OF PARTS

The complete equipment comprises the following parts:—

1.1. One instrument Type 442 fitted with the following valves:—

Four—CV138 (Brimar or Mullard) or equivalent.
Three—CV2127 (Brimar or Mullard) or equivalent.
One—CV449 (Mullard).
One—1CP1 Cathode-ray Tube (Emitron).

Also:

Two—CV448 Crystal Diodes (Mullard).
Two—Cartridge Fuse, Brush 1 amp. Z590109 for 200–250V operation, or 2 amp. Z590110 for 110–120V operation.
One—6·5 volt 0·3 amp. M.E.S. cap Pilot Lamp, Ref. No. 5L/2130.

1.2. One set—Tilting bars for bench mounting, together with four fixing screws.

1.3. One—Mains lead complete with 3-pin socket.

1.4. One—Instruction Book IB 442.

2. DESCRIPTION

2.1. Application

The V.L.F. Oscillator Type 442 is a precision grade instrument having an unusual degree of flexibility for measurements at audio and sub-audio frequencies.

The wide frequency range and constant output level make the instrument ideal for measuring the frequency response characteristics of low frequency amplifiers used, for example, in geophysical and electro-medical research.

The rapid response of the automatic amplitude control circuit, combined with the ability to tune continuously from 0·1 c/s through subsonic and audio frequencies, is essential for vibration and strain investigations in machines and structures, and for checking the response of low frequency recorders.

The provision of two output signals in quadrature is particularly valuable for the testing of servo systems.

In addition, the instrument can be used for all normal audio frequency work.

2.2. Design

The instrument employs a novel selective amplifier circuit with controlled positive feedback to maintain continuous oscillation. The amplifier consists of a phase inverter followed by two integrating stages, and is made selective by overall negative feedback.

The positive feedback circuit includes a symmetrical diode limiter. The constant amplitude rectangular waveform from the limiter is applied to the input of the amplifier, and due to the high selectivity the harmonic content of the output signal is reduced to negligible proportions.

The diode limiter provides a rapid automatic amplitude control effective down to the lowest frequency of 0·1 c/s. After a sudden transient, for example, when changing ranges, the amplitude of oscillation is stabilised within a few cycles at all frequencies. This is a considerable advantage over the commonly employed thermal automatic amplitude control circuits which, in general, cannot be used at very low frequencies.

At the frequency of oscillation, each integrator provides a phase shift of very nearly 90°. Thus a quadrature output is made available after the first integrator stage.

The output impedance of each integrating stage is very low, so that the specified load impedance can be connected directly without affecting the performance of the oscillator.

The gain of the amplifier is virtually independent of valve characteristics and mains voltage variations. The negative d.c. feedback automatically sets all the valve stages to the proper operating conditions, and the d.c. content in the output does not exceed 0·1 volt over the entire frequency range.

The output signals are monitored on a miniature cathode-ray tube. Provision is made for connecting an external signal to the X plates of the cathode-ray tube.

The circuit design is described in the article "A 2-Phase Low Frequency Oscillator" by E. F. Good, ELECTRONIC ENGINEERING, Part 1, April 1957, pp. 164–169, and Part 2, May 1957, pp. 210–213.

Particular care has been taken with the mechanical design of the equipment to ensure maximum ventilation, and as a result, the thermal stability is very good. The natural flow of air passes in through the louvres at the rear of the dust cover and out through vent holes in the front panel. The valves are mounted horizontally in a recess in the front panel, and the bright aluminium walls of this recess reflect the heat radiated by the valves away from the instrument.

The development of the mechanical construction is described in the article "Heat Control in Electronic Equipment" by E. N. Shaw, ELECTRONIC ENGINEERING, Part 1, January 1957, pp. 13–23, Part 2, February 1957, pp. 65–70, and Part 3, March 1957, pp. 115–118.

The equipment is suitable for mounting in a standard 19-in. Post Office type rack. Since all the heat is thrown forward from the front panel, no special precautions are necessary to avoid heating other instruments in the rack.

For bench mounting at a convenient angle, removable tilting bars are supplied.

The instrument is a commercial version of a Ministry of Supply Inter-Service equipment based on an original design of the Radar Research Establishment, and is the subject of a British Patent Application.

3. INSTALLATION

3.1. Mounting

This instrument is normally supplied for bench mounting with tilting bars secured to the front panel.

For rack mounting, the four corner screws in the front panel can be removed and the instrument lifted from the tilting bars. With the tilting bars and the screws removed, the instrument fits directly into a standard 19-in. Post Office type rack and is secured by the slots provided at the normal fixing centres.

As a result of the mechanical design which has been employed, no special precautions to avoid heating other equipment in the rack are necessary.

3.2. Power Supply

For supplies other than that stated on the label, it will be necessary to change the primary connections to the mains transformer. Access to the mains transformer can be obtained by unscrewing the four captive retaining screws at the back of the dust cover and withdrawing the instrument. The input leads to the transformer, which is located on the left-hand end-frame, must be unsoldered and re-soldered to the taps nearest to the required nominal mains supply voltage.

Connect to the power supply by means of the mains lead provided:—

Red ..... Mains (Line)
Black ..... Mains (Neutral)
Other colour ..... Earth

A good earth is desirable to minimise any possible hum pickup.

3.3. Valves

These are normally supplied in their holders. Access to the valves can be obtained by removing the four 6 B.A. screws holding the metal guard.

4. OPERATION

4.1. Warm-up Period

Normally the instrument is ready for operation five minutes after switching on. This time is required for the heaters to warm up and for the voltages to stabilize. However, when first put into operation, or after standing idle for a long time, the instrument should be run for 20–30 minutes. The output voltage on switching on is about 3% higher than the final stabilized value, and the initial drift in frequency is about 0·25%.

4.2. Output

The output frequency is selected by the main FREQUENCY c/s dial and MULTIPLY BY range switch. The range switch indicates the multiplying factor to be used to obtain the frequency reading directly in c/s.

The maximum output voltage is 25V for both 0° and 90° OUTPUTS. (Earth and either of the red 25V terminals.)

If this output is not obtained after the instrument has been running for 30 to 60 minutes, set the frequency to 300 c/s and turn the 25V ADJUST control on the front panel until the 0° output is exactly 25V. A screwdriver is necessary to operate this control, which is fitted with a friction anti-vibration device.

Both output phases are fitted with continuously variable potentiometers marked 0° OUTPUT and 90° OUTPUT respectively. These variable outputs are available between each ATT. terminal and the earth terminal.

4.3. D.C. Level

Provision is made for re-setting the d.c. level of each output if required as follows.

Set the oscillator to 3 kc/s and connect a 20,000Ω/V meter (e.g. Model 8 Avometer) on the 10V d.c. range to the 90° OUTPUT red terminal and earth. Adjust the 90° D.C. LEVEL

Use only 'Avo' 8, NOT Venture meter. Use of a different meter produces conflicting results. Use 10V range only.

pre-set control until the d.c. level of the 90° output is zero (±0·1V).

Similarly set the 0° output by means of the 0° D.C. LEVEL pre-set control and then check the 90° output.

4.4. Output Monitor

The outputs are monitored on a miniature cathode-ray tube in the 0 position of the switch to the left of the tube. Since the outputs are in quadrature, an approximately circular trace is obtained with the velocity determined by the frequency setting.

In the ∞ position of the switch, an external input can be applied between the EXT. INPUT and earth terminals to provide an X deflection. A signal of about 15 to 30 volts r.m.s. into 1MΩ is required to produce a useful deflection. The Y deflection is obtained from the 90° output of the oscillator.

The brilliance of the trace may be adjusted, if necessary, by a pre-set potentiometer mounted internally adjacent to the cathode-ray tube. To gain access to the potentiometer, the dust cover must be removed as described in Section 3.2.

5. MAINTENANCE

5.1. Valves

These are not specially selected. Access to the valves can be obtained as described in Section 3.3.

If a tube is changed, the output amplitude and d.c. level should be checked as described in Sections 4.2 and 4.3.

5.2. Pilot Lamp and Fuses

These can be removed by unscrewing the respective holders on the front panel.

5.3. Cathode-Ray Tube

To change the cathode-ray tube, remove the dust cover as described in Section 3.2, slacken the screw on the retaining circular clip, pull the tube from its valve holder and remove the tube through the front panel.

5.4. Output Voltage

The output voltage is set to 25V on all ranges by means of the respective pre-set potentiometers at the back of the instrument. Normally these need no adjustment; however, if in doubt the settings can be checked as follows.

Run the instrument for 30 to 60 minutes.

Connect an accurate valve voltmeter to the 0° OUTPUT between red (25V) and earth terminals, set the FREQUENCY dial to " 3," MULTIPLY BY switch to X10 (i.e. 30 c/s) and adjust the ADJUST 25V control on the front panel to obtain exactly 25 volts r.m.s.

Connect a direct-coupled oscilloscope to the 0° OUTPUT and measure the peak-to-peak deflection on the screen (70·7V).

Switch the MULTIPLY BY switch to X1 and, if necessary, adjust the 1–10 c/s pre-set potentiometer at the rear of the instrument until the peak-to-peak deflection is the same as at 30 c/s.

Repeat on the X0·1, X100 and X1,000 ranges using the 0·1–1 c/s, 100 c/s–1 kc/s and 1–10 kc/s pre-set potentiometers respectively. If desired, the X100 and X1,000 ranges can be set directly by means of the valve voltmeter.

On the X1,000 range the trimmer VC1, located in the centre section of the instrument near the valve deck, must be adjusted until the output voltage at 10 kc/s is also exactly 25V.

6. SPECIFICATION

Frequency Range: 0·1 to 10,000 c/s in five decades.

Calibration Accuracy: ±3% of scale reading. Scale hand-calibrated with an accuracy of ±1% on the 100 c/s–1 kc/s range.

0° Output:

Output Level. 25V maximum, continuously variable, into a minimum load of 10kΩ.

Output level within ±4% over the entire frequency range.

Distortion. Less than 0·5% total over the measured range 20 c/s to 10 kc/s. Typical harmonic content at 400 c/s:—

2nd harmonic 0·1%.
3rd harmonic 0·3%.
4th harmonic 0·01%.
5th harmonic 0·06%.

All others less than 0·05%. Hum and noise less than 0·1%.

90° Output:

Phase Accuracy. 90°±0·5° lagging referred to 0°. Output measured at 400 c/s.

Output Level. 25V maximum, continuously variable, into a minimum load of 10kΩ. Maximum output within ±2% of 0° maximum output.

Distortion. Less than 1·5% total over the measured range 20 c/s to 10 kc/s.

Typical harmonic content at 400 c/s:—

2nd harmonic 0·1%.
3rd harmonic 0·9%.
4th harmonic 0·01%.
5th harmonic 0·3%.

All others less than 0·1%. Hum and noise less than 0·1%.

External Input: An external signal of about 15 to 30 volts r.m.s. into 1MΩ is required to produce a useful deflection on the cathode-ray tube.

Power Supply: 110–120V and 200–250V, 50–60 c/s, 75W.

Mounting: Light-weight rack-mounting construction. Detachable tilting bars supplied for bench mounting.

Dimensions: Panel fixing centres $5\frac{3}{4}$ in. (146 mm). Rack mounting 19 in. × $8\frac{3}{4}$ in. × 8 in. deep (485 mm × 220 mm × 205 mm).

Bench mounting 19 in. × $10\frac{1}{2}$ in. × 10 in. deep overall (485 mm × 266 mm × 255 mm).

Weight: 28 lb (12·7 kg) rack mounting.

30 lb (13·6 kg) bench mounting.

7. GUARANTEE

Our products are carefully inspected and submitted to comprehensive tests at our factory before despatch. We therefore give to all purchasers (subject to the terms of payment and all the customer's other obligations being strictly observed) the following guarantee, which excludes and takes the place of any condition or warranty implied by Statute or otherwise.

If within three years from the date of despatch, any defect is discovered in any apparatus in respect of material or workmanship and reasonably within our control, we undertake to make good the defect at our own expense, provided notice is given to us as soon as it is discovered, and that the apparatus is immediately forwarded to our factory, carriage paid and with seals unbroken. Our responsibility is in all cases limited to the cost of making good the defect in the apparatus itself. This guarantee is given to our customers and does not extend to third parties, nor does it apply to defects caused by wear and tear, abnormal conditions of working, accident, misuse or neglect.

In the case of material or components not of our manufacture, we are prepared to give the customer the benefit of any guarantee given us in respect thereof.

8. SERVICING PROCEDURE

The information given in this booklet should enable the user to maintain the equipment in proper working order. If difficulties arise, please write or telephone our Service Department or our Representative or Agent for your area or country. In certain cases we may be able to arrange for an outside service engineer to call on you.

When contacting our Service Department please mention the serial and type numbers of your instrument and include a full report of the fault encountered, as well as details of the action taken to eliminate it.

This information should be addressed to:—

Service Department,
Dawe Instruments Ltd.,
7/9 Spur Road,
ISLEWORTH, Middlesex
Telephone No. ISLeworth 8323.

If the equipment is returned for service, please include a copy of any relevant correspondence, together with all the accessories and the Instruction Book.

This procedure will facilitate the work of our Service Department and expedite the return of the instrument.

Cir. Ref.	COMPONENT	Ref. No.	Value	Tol.	Ratg.
	RESISTORS				
R1	Painton W.W.	Z.244216	2·2kΩ	± 5%	1½W.
R2	Erie Grade 2 Comp. ...	Z.222222	47kΩ	10%	1W.
R3	Welwyn Grade 1 Comp.	Z.216072	39kΩ	± 5%	½W.
R4	Painton W.W.	Z.244232	4·7kΩ	± 5%	1½W.
R5	Painton W.W.	Z.244232	4·7kΩ	± 5%	1½W.
R6	Welwyn Grade 1 Comp.	Z.216072	39kΩ	± 5%	½W.
R7	Erie Grade 2 Comp. ...	Z.222222	47kΩ	10%	1W.
R8	Welwyn Grade 1 Comp.	Z.216541	100kΩ	± 2%	½W.
R9	Welwyn Grade 1 Comp.	Z.216122	100kΩ	± 5%	½W.
R10	Welwyn Grade 1 Comp.	Z.216122	100kΩ	± 5%	½W.
R11	Erie Grade 2 Comp. ...	Z.223133	560kΩ	± 10%	¼W.
R12	Welwyn Grade 1 Comp.	Z.216541	100kΩ	± 2%	½W.
R13	Erie Grade 2 Comp. ...	Z.221109	100Ω	± 10%	¼W.
R14	Erie Grade 2 Comp. ...	Z.223091	270kΩ	± 10%	¼W.
R15	Erie Grade 2 Comp. ...	Z.223060	150kΩ	± 10%	¾W.
R16	Welwyn Grade 1 Comp.	Z.216594	470kΩ	± 2%	½W.
R17	Welwyn Grade 1 Comp.	Z.216658	1MΩ	± 2%	½W.
R18	Erie Grade 2 Comp. ...	Z.221109	100Ω	± 10%	¼W.
R19	Welwyn W.W.... ...	Z.244129	22kΩ	± 5%	6W.
R20	Welwyn Grade 1 Comp.	Z.216247	15kΩ	± 1%	½W.
R21	Erie Grade 2 Comp. ...	Z.221109	100Ω	± 10%	¼W.
R22	Erie Grade 2 Comp. ...	Z.223060	150kΩ	± 10%	¾W.
R23	Erie Grade 2 Comp. ...	Z.222016	1·2kΩ	± 10%	¼W.
R24	Welwyn Grade 1 Comp.	Z.216594	470kΩ	± 2%	½W.
R25	Welwyn Grade 1 Comp.	Z.216658	1MΩ	± 2%	½W.
R26	Erie Grade 2 Comp. ...	Z.221109	100Ω	± 10%	¼W.
R27	Welwyn W.W.	Z.244113	15kΩ	± 5%	4½W.
R28	Erie Grade 2 Comp. ...	Z.223163	1MΩ	± 10%	¼W.
R29	Welwyn Grade 1 Comp.	Z.216247	15kΩ	± 1%	½W.
R30	Erie Grade 2 Comp. ...	Z.221109	100Ω	± 10%	¼W.
R31	Erie Grade 2 Comp. ...	Z.223060	150kΩ	± 10%	¾W.
R32	Welwyn W.W.... ...	Z.244113	15kΩ	± 5%	4½W.
R33	Welwyn W.W.... ...	Z.244129	22kΩ	± 5%	6W.
R34	Welwyn W.W.... ...	Z.244141	33kΩ	± 5%	6W.
R35	Welwyn W.W.... ...	Z.244150	47kΩ	± 5%	6W.
R36	Painton W.W.	Z.244155	68kΩ	± 5%	6W.
R37	Erie Grade 2 Comp. ...	Z.222172	22kΩ	± 10%	¼W.
R38	Welwyn Grade 1 Comp.	Z.216594	470kΩ	± 2%	½W.
R39	Erie Grade 2 Comp. ...	Z.221109	100Ω	± 10%	¼W.
R40	Welwyn Grade 1 Comp.	Z.216658	1MΩ	± 2%	½W.
R41	Erie Grade 2 Comp. ...	Z.223247	4·7MΩ	± 10%	¼W.
R42	Erie Grade 2 Comp. ...	Z.223247	4·7MΩ	± 10%	¼W.
R43	Erie Grade 2 Comp. ...	Z.221109	100Ω	± 10%	¼W.
R44	Welwyn Grade 1 Comp.	Z.216002	10kΩ	± 5%	½W.
R45	Welwyn Grade 1 Comp.	Z.216746	680kΩ	± 5%	½W.
R46	Welwyn W.W.... ...	Z.244113	15kΩ	± 5%	4½W.
R47	Erie Grade 2 Comp. ...	Z.223039	100kΩ	± 10%	¾W.

Cir. Ref.	CAPACITORS	Ref. No.	Value	Tol.	Ratg.
C1	Silvered Mica. L.E.M.	Z.123909	33pF	±10%	
C2	Silvered Mica. L.E.M.	Z.123913	47pF	±10%	
C3	Silvered Mica. L.E.M.	Z.123913	47pF	±10%	
C4	Silvered Mica. L.E.M.	Z.123913	47pF	±10%	
C5	Silvered Mica. L.E.M.	Z.123909	33pF	±10%	
C6	Silvered Mica. L.E.M.	Z.123920	82pF	± 2%	
C7	Silvered Mica. L.E.M.	Z.123909	33pF	±10%	
C8	Muirhead 234 AT ...		10μF	± 1%	
C9	Muirhead 234 AT ...		1μF	± 1%	
C10	Muirhead M81 ...		0·1μF	± 1%	
C11	Silvered Mica. L.E.M.	Z.124372	0·01μF	± 2%	
C12	Silvered Mica. L.E.M.	Z.124700	0·001μF	± 1%	
C13	Silvered Mica. L.E.M.	Z.123909	33pF	±10%	
C14	Muirhead 234 AT ...		10μF	± 1%	
C15	Muirhead 234 AT ...		1μF	± 1%	
C16	Muirhead M81 ...		0·1μF	± 1%	
C17	Silvered Mica. L.E.M.	Z.124372	0·01μF	± 2%	
C18	Silvered Mica. L.E.M.	Z.124700	0·001μF	± 2%	
C19	Silvered Mica. L.E.M.	Z.123909	33pF	±10%	
C20	Hunts Electrolytic ...	Z.145601	32·32μF		350V
C21	Hunts Electrolytic ...	Z.145601			
C22	Hunts Electrolytic ...	Z.145601	32·32μF		350V
C23	Hunts Electrolytic ...	Z.145601			
C24	Dubilier Tub. Pap....	Z.115590	0·25μF		500V
C25	Dubilier Tub. Pap....	Z.115590	0·25μF		500V
C26	T.C.C. Rect. Paper...	Z.111377	0·5μF		1,000V
C27	T.C.C. Type CP33S*		0·01μF		350V

Cir. Ref.	MISCELLANEOUS	Ref. No.	Value	Tol.	Ratg.
RV1	Colvern W.W. R.C.L.121 Style R.V.W.1	Z.272141	10kΩ		
RV2	Colvern W.W. R.C.L.121 Style R.V.W.1		5kΩ		
RV3	Colvern W.W. R.C.L.121 Style R.V.W.1		5kΩ		
RV4	Colvern W.W. R.C.L.121 Style R.V.W.1		5kΩ		
RV5	Colvern W.W. R.C.L.121 Style R.V.W.1		5kΩ		
RV6	Reliance Ganged to RV8 and RV9		500Ω		
RV7	Colvern W.W. R.C.L.121 Style R.V.W.1		5kΩ		
RV8	Reliance. Ganged to RV6 and RV9		155kΩ		
RV9	Reliance. Ganged to RV6 and RV8		155kΩ		
RV10	ColvernW.W. R.C.L.121	Z.272409	50kΩ		
RV11	Colvern W.W. R.C.L.121 Style R.V.W.1		5kΩ		
RV12	Morgan Comp. R.C.L.121	Z.262543	500kΩ		
RV13	Colvern W.W. R.C.L.121	Z.272409	50kΩ		
SW1	Switch N.S.F. Wafer R.C.L.154A (C8171)				
SW2	Switch N.S.F. Toggle	Z.510554			
SW3	Switch N.S.F. Toggle	Z.510554			
F1	200–250V operat'n 1 amp	Z.590109			
F2	110–120V operat'n 2 amp	Z.590110			
PL1	Plug Bulgin P73 10H/1095				
LP1	Indicator Lamp 6·5V 0·3A Type SL/2130				
MR1	Westinghouse T15B144				
MR2	Westinghouse T15B144				
MR3	Westinghouse T15D47				
T1	Mains Trans. Parmeko 6000/69				
L1	Smoothing Choke Parmeko 6000/34				
L2	Smoothing Choke Parmeko 6000/34				
L3	Smoothing Choke Parmeko 6000/34				
L4	Smoothing Choke Parmeko 6000/34				
VC1	Var. Capac. Pre-set Oxley		2·32pF		
V1	CV.449 (84V Neon)				
V2	CV.448 (Crystal Diodes)				
V3	CV.448 (Crystal Diodes)				
V4	CV.138				
V5	CV.2127				
V6	CV.138				
V7	CV.2127				
V8	CV.138				
V9	CV.138				
V10	CV.2127				
V11	I.C.P.I. Emitron C.R.T.				

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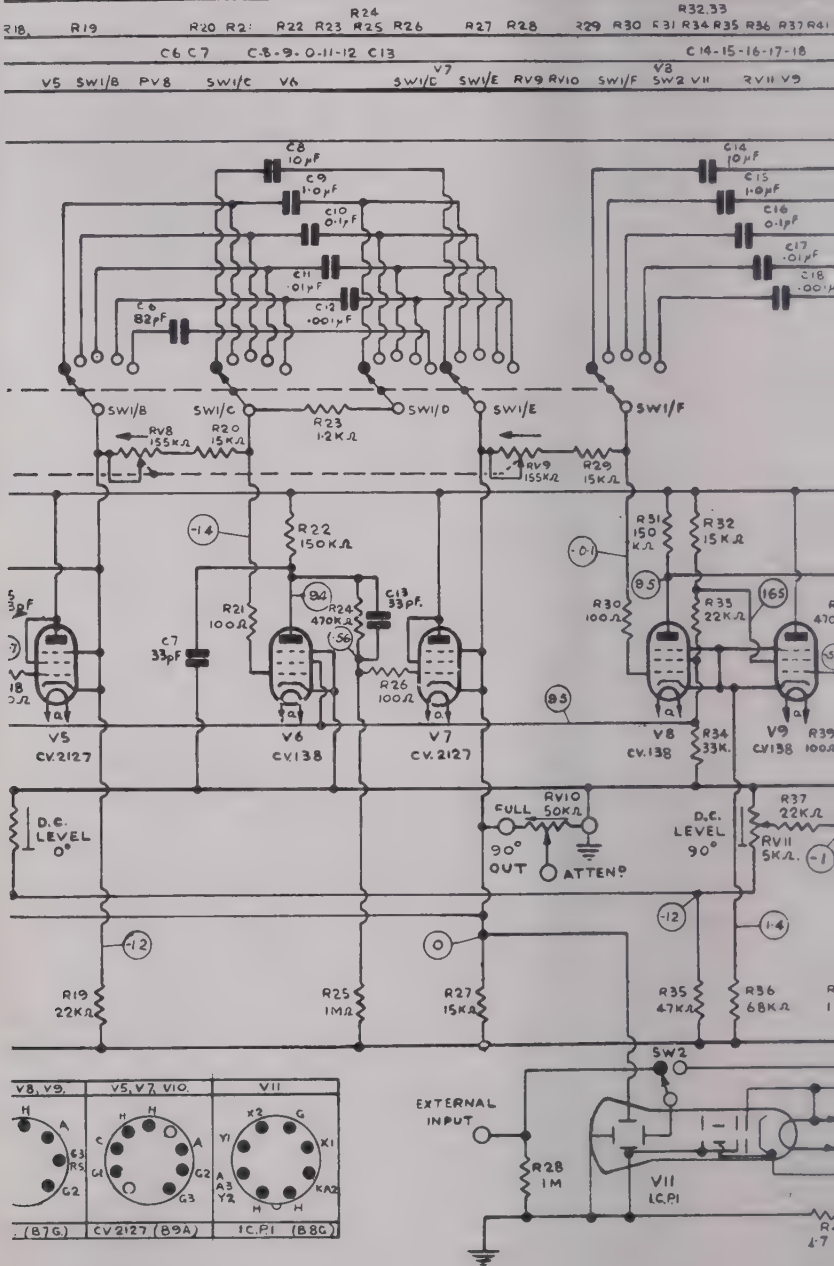
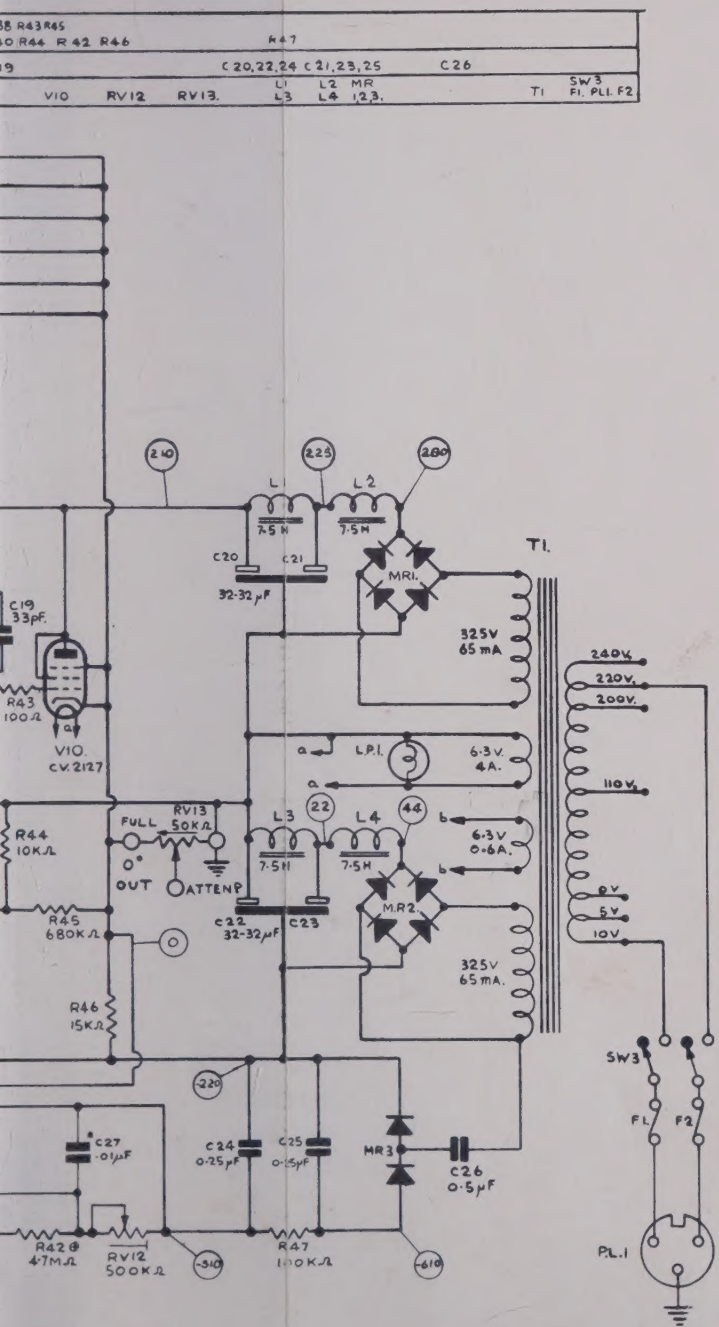


CIRCUIT DIAGRAM No. E.8175


38 R43 R65
40 R44 R42 R46
R47
19
C20,22,24
C21,23,25
C26
V10
RV12
RV13.
L1
L2
MR
L3
L4
1,2,3.
T1
SW3
F1. PL1. F2
240
225
200
L1
L2
7·5 H
7·5 H
C20
C21
32-32 μF
MR1.
T1.
C19
33pF.
R43
100Ω
V10.
CV.2127
325V
65 mA
240V.
220V.
200V.
110V.
6·3V.
4A.
L.P.1.
RV13
FULL
50KΩ
0°
OUT
ATTENP
R44
10KΩ
R45
680KΩ
R46
15KΩ
L3
L4
22
44
7·5H
7·5H
6·3V.
0·6A.
C22
32-32 μF
C23
MR2.
325V
65 mA.
8V
5V
10V
SW3
F1
F2
P.L.1
C27
·01μF
C24
0·25μF
C25
0·15μF
MR3
C26
0·5μF
R42
4·7MΩ
RV12
500KΩ
R47
100KΩ
-220
-340
-610

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